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ABSTRACT

This report contains the findings of the National Science Foundation (NSF) Survey of Scientific and Engineering Expenditures at Universities and Colleges, in Fiscal Year (FY) 1978. Results of a survey are reported from 320 academic institutions with doctoral programs in the sciences and/or engineering. Estimates made by NSF staff for nonrespondents represent 4% of the total academic R&D spending at doctoral universities. The 1972 constant dollars are based on the gross national product (GNP) implicit price deflator. (Author)

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SCIENCE RESOURCES STUDIES HIGHLIGHTS

NATIONAL SCIENCE FOUNDATION WASHINGTON, D.C. 20550 MARCH 3, 1980 NSF 80-301

Doctoral Institutions Report 6% Real Increase in R&D Expenditures in FY 1978

This report contains the findings of the National Science Foundation's (NSF) Survey of Scientific and Engineering Expenditures at Universities and Colleges, FY 1978. The survey was mailed to 326 academic institutions with doctoral programs in the sciences and/or engineering. Estimates made by NSF staff for nonrespondents represent 4 percent of total academic R&D spending at doctoral universities. The 1972 constant dollars are based on the gross national product (GNP) implicit price deflator.

Highlights

- Both Federal and non-Federal sources have been responsible for four consecutive years of real growth in academic R&D funding, producing an 11-percent increase in real terms since 1974.

- R&D expenditures by doctorate-degree-granting universities account for 98 percent of all organized research in academe. Based on these institutions, R&D spending in all institutions of higher education is estimated at $4.6 billion in fiscal year 1978—an increase of 13 percent over 1977 levels and 6 percent when measured in constant dollars. This represents the largest rate of real growth since the midsixties.

- Three related indicators of university R&D activity have also steadily increased between 1974 and 1977—graduate research assistants, up 11 percent; and postdoctorates, up 18 percent. In addition, scientific and engineering (S/E) professionals engaged in R&D activities have increased each year from January 1975 through 1978, for an overall growth of 10 percent.

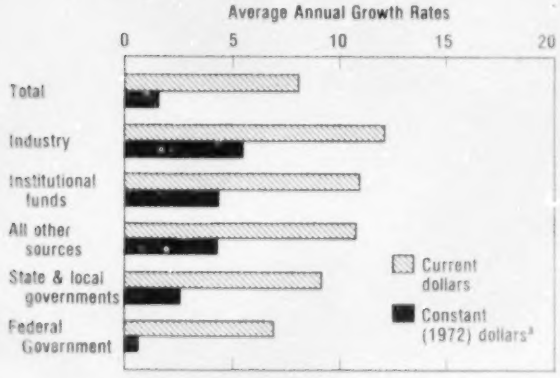
- As for institutions' own funds, university officials, particularly at private institutions, have indicated that rising energy and administrative costs and generally unfavorable economic conditions may force institutions to curtail their own support of research programs.

- In constant dollars, Federal R&D funds increased 5 percent in 1978, slightly more than the average 3 percent annual rate at which Federal funds have increased since 1974. 1974 was the low point in constant-dollar Federal support during the 1968-78 period and subsequent increases partially reflect more emphasis on the support of basic research, which is primarily conducted in the university sector. Estimates of Federal R&D funding to universities for 1979 and 1980, based on Federal budget proposals, show Federal funding increasing but below expected rates of inflation.

- Industry-supported R&D funding, while constituting only 11 percent of the non-Federal total, increased 15 percent in constant dollars between 1977 and 1978. Since 1974 industrial R&D support has expanded at the fastest pace among all academic R&D sponsors, averaging real-dollar growth of 7 percent per year.

- R&D spending increased for all major S/E disciplines in 1978, with the largest relative increase occurring in engineering, up 19 percent. Since 1968 average annual growth rates ranged from 13 percent in the environmental sciences to less than 5 percent in the physical sciences.

Chart 1. R&D expenditures at doctorate-granting universities by source: FY 1968-78



[a]Based on GNP implicit price deflator

SOURCE: National Science Foundation

Prepared in the Universities and Nonprofit Institutions Studies Group, Division of Science Resources Studies

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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Sources of Support

A variety of organizations—including Federal agencies, corporations, and numerous nonprofit organizations—fund academic R&D projects, with the largest source being the Federal Government. Since 1968, the Federal portion of total academic research and development, however, has been shrinking—from 73 percent in 1968 to 66 percent in 1978. This relative decline occurred between 1968 and 1974 when a 1-percent per year drop in constant-dollar support was experienced. Since 1974, Federal R&D funds have risen at an average rate of 3 percent per year in real terms (chart 1). Even during the 1974-78 period, non-Federal funds continued to represent an increasing percentage of academic R&D support as the contributions by industry, State and local governments, and universities have expanded at rates exceeding that of the Federal Government (chart 2). For example, from 1974 to 1978 both corporate and institutional R&D support increased an average of 7 percent per year in constant dollars, more than double the Federal rate. Growth in non-Federal support was also evident in 1978 when the constant-dollar Federal R&D growth, 5 percent, was exceeded by both industry funds, up 15 percent, and institutional support, up 14 percent. This difference in growth rates was particularly significant since the rate of increase of Federal R&D support was the largest in more than a decade.

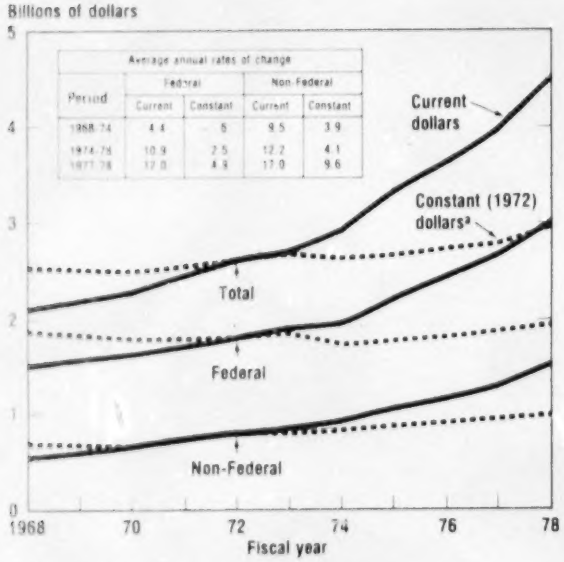
Officials at nine large research universities were asked to explain the increase in institutional funds. They most frequently cited university-instituted programs designed to enhance the professional development of young investigators by providing support for their initial research projects. These officials noted, however, that the ability to establish or expand such programs will be limited in the future by increasing demands on the financial resources of universities (i.e., energy, inflation, etc.).

Field of Science

Doctoral institutions reported that R&D spending increased for all major S/E fields in 1978. In six of the seven major areas, this increase exceeded the average annual growth rate for the entire 1968-78 period. In current dollars engineering expenditures rose at the fastest pace, 21 percent, between 1977 and 1978, followed next by the 19-percent rise in the environmental sciences. Only the social sciences and psychology reported a growth rate below the 1978 inflation rate of 7 percent (chart 3).

R&D spending in the various S/E disciplines has been generally related to the evolution of missions and interests of sponsoring Federal agencies. For example, the large R&D increase in engineering in 1978 is traceable to a decision by the Department of Defense to increase the share of its technology base funds going to academia.[1] The effect of this decision was reflected in an increase of more than 31 percent in engineering research obligations for academic R&D activities by the Services in 1977 and was reported by universities one year later because of the normal lag between obligations by Federal agencies and expenditures by institutions.[1] Furthermore, the growing commitment of several agencies toward the solution of energy and

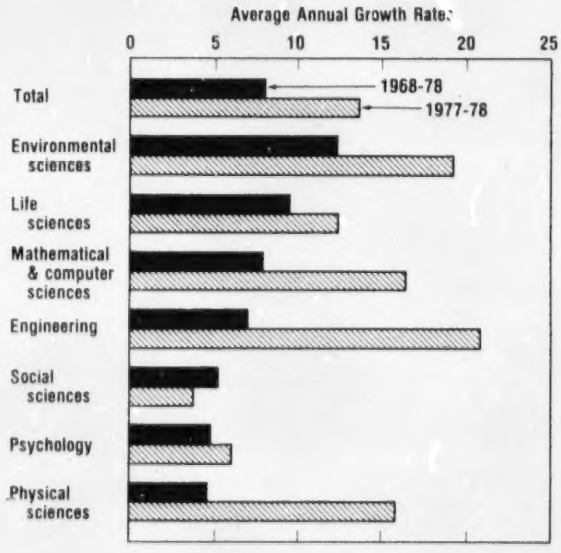
Chart 2. R&D expenditures at doctorate-granting universities by source



[a]Based on GNP implicit price deflator

SOURCE: National Science Foundation

Chart 3. R&D expenditures at doctorate-granting universities by field

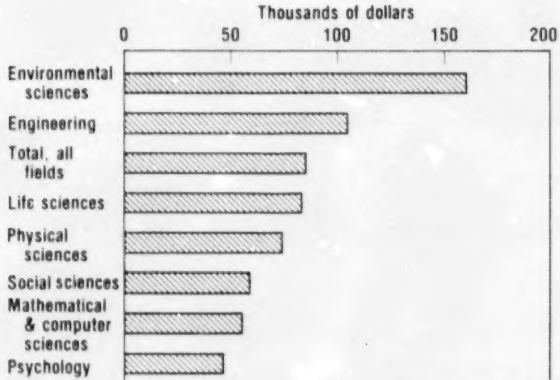


SOURCE: National Science Foundation

environmental problems corresponded with a decline in space-related programs, which were evolving from fundamental to applied research and developmental stages. As a result, engineering and the environmental sciences have played an increasing role in academic R&D activities. The relative share accounted for by the physical sciences has shrunk from 15 percent to 11 percent between 1968 and 1978. However, physical sciences increased by almost 16 percent in 1978 over 1977 as compared to the average annual rate of less than 5 percent during the 1968-78 period (chart 3).

The financial resources required to perform academic research are significantly different among the S/E disciplines because of varying cost components. Equipment-intensive areas like oceanography, physics, and astronomy have increasingly required more sophisticated scientific apparatus over the last decade. In these S/E areas and in the life sciences, substantial technical personnel support, as well as instrumentation needs, are reflected in research costs. In contrast, mathematical and social science research costs are largely limited to salaries and stipends. By themselves, wages as a cost component also vary among S/E fields depending upon job market conditions. The disparate costs which result from these factors are reflected in chart 4 which shows that R&D expenditures per FTE scientist and engineer engaged in R&D activities in 1978 ranged from less than $50,000 in psychology to more than $160,000 in the environmental sciences. What is not reflected in this chart is the adequacy of funding of R&D projects which may change over time as the scope of work in research projects is scaled in response to available resources. For example, some believe that in the seventies scientists responding to diminishing shares of permanent equipment in Federal project grants tended "to plan more conservatively and to be less innovative in shaping proposals in order to make do with existing instrumentation and facilities."[1]

Chart 4. R&D expenditures at doctorate-granting universities per FTE scientist/engineer employed in R&D activities by field: FY 1978



SOURCE: National Science Foundation

Institutional Distribution

A relatively small number of the more than 3,000 institutions of higher education account for the bulk of academic R&D expenditures. These major research universities serve as the primary vehicles for graduate S/E training which is intrinsically linked to the conduct of research. For example, the 100 leading doctoral institutions in terms of R&D spending accounted for 84 percent of both the academic R&D total and the federally supported R&D total in 1978. Similarly these same universities accounted for 69 percent of full-time graduate S/E enrollment and 85 percent of post-doctorates in fall 1977.

Massachusetts Institute of Technology ($120 million) replaced the University of Wisconsin at Madison ($108 million) as the leading academic R&D performer in 1978 (table 1). Pennsylvania State University ($64 million) reported the largest absolute increase among the largest R&D performers in 1978, reflecting the recent inclusion of the Applied Research Laboratory (formally classified as an FFRDC) as an integral component of the university. Ninety-three of the top 100 universities reported R&D increases in 1978.

Table 1. Twenty institutions reporting the largest R&D expenditures in the sciences and engineering: FY 1978

(Dollars in thousands)

Institution	Total		Federal	
	1978	Percent change, 1977-78	1978	Percent change, 1977-78
Total, all doctorate-granting universities	$4,530,112	14	$3,003,077	12
Total, leading 20 universities	1,580,471	12	1,152,075	11
1. MIT	119,620	17	102,131	20
2. Univ. of Wisconsin-Madison	107,939	8	68,870	8
3. Univ. of Calif.-San Diego	95,246	9	83,848	7
4. Univ. of Minnesota	94,706	15	53,265	10
5. Univ. of Washington	89,014	15	74,927	13
6. Stanford Univ.	88,198	15	78,706	11
7. Univ. of Michigan	86,886	9	58,436	15
8. Harvard Univ.	[1]84,150	15	63,687	15
9. Cornell Univ.	83,380	17	54,730	19
10. Univ. of Pennsylvania	76,493	8	52,399	11
11. Columbia Univ.	74,619	2	59,862	2
12. Univ. of Illinois-Urbana	73,850	24	42,019	4
13. Univ. of Calif.-Los Angeles	72,279	4	57,991	4
14. Univ. of Calif.-Berkeley	70,307	[2]	49,791	-1
15. Johns Hopkins Univ.	65,249	6	53,777	7
16. Pennsylvania State Univ.[3]	64,435	45	42,392	64
17. Univ. of Texas-Austin	59,817	20	39,184	30
18. Texas A&M Univ.	59,594	15	25,123	16
19. Univ. of Chicago	58,105	-2	44,197	-4
20. Univ. of Calif.-San Francisco	56,584	14	46,740	13
Total, all other doctorate-granting universities	2,949,641	15	1,851,002	12

[1]Estimate.

[2]Change of less than 0.5 percent.

[3]Included in 1978 data is the Applied Research Laboratory, previously classified as a FFRDC.

SOURCE: National Science Foundation.

Institutional Control

While R&D expenditures by both publicly and privately controlled doctoral universities increased in real terms in 1978, the constant-dollar growth rate by the former, 7 percent, exceeded the rate at private schools, 5 percent.

During the 1968-78 period, R&D funds increased in real terms at an average rate of 3 percent per year in public universities compared to a 1-percent per year decline in private institutions. As a result, public universities have performed an ever increasing share of the academic R&D total, performing 65 percent of the total in 1978. Possibly related is the fact that public institutions have increasingly accounted for larger shares of graduate enrollment (70 percent in 1976 versus 66 percent in 1968).[9]

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Academic Science: R&D Funds, Fiscal Year 1978 (Detailed Statistical Tables) (NSF 79-320) can be obtained from the Division of Science Resources Studies, National Science Foundation, Washington, D.C. 20550. For information on availability of data tapes, please call Mosnman Associates, Inc., at 301-229-3000.

Footnotes

[1] National Science Foundation. *Graduate Science Education: Student Support and Postdoctorals, Fall 1977* (Detailed Statistical Tables) (NSF 78-315) (Washington, D.C., 1978.)

[2] National Science Foundation. *Human Resources for Scientific Activities at Universities and Colleges, January 1978* (Detailed Statistical Tables) (NSF 78-318) (Washington, D.C., 1978.)

[3] Dr. John L. Allen, *Statement on Department of Defense Laboratories before Subcommittee on Research and Development of the Committee on Armed Services, 95th Congress, 1st Session* (March 28, 1977).

[4] National Science Foundation. *Federal Funds for Research, Development, and Other Scientific Activities, Fiscal Years 1976, 1977, and 1978*, Volume XXVI (Detailed Statistic Tables) (NSF 77-317) and *Federal Funds for Research and Development, Fiscal Years 1977, 1978, and 1979*, Volume XXVII (Detailed Statistical Tables) (NSF 78-312) (Washington, D.C.)

[5] Ford Foundation. *Research Universities and the National Interest: A Report from Fifteen University Presidents*. (New York: 1978.)

[6] Department of Health, Education, and Welfare, National Center for Education Statistics. *Projections of Education Statistics to 1986-87* (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, 1978.)